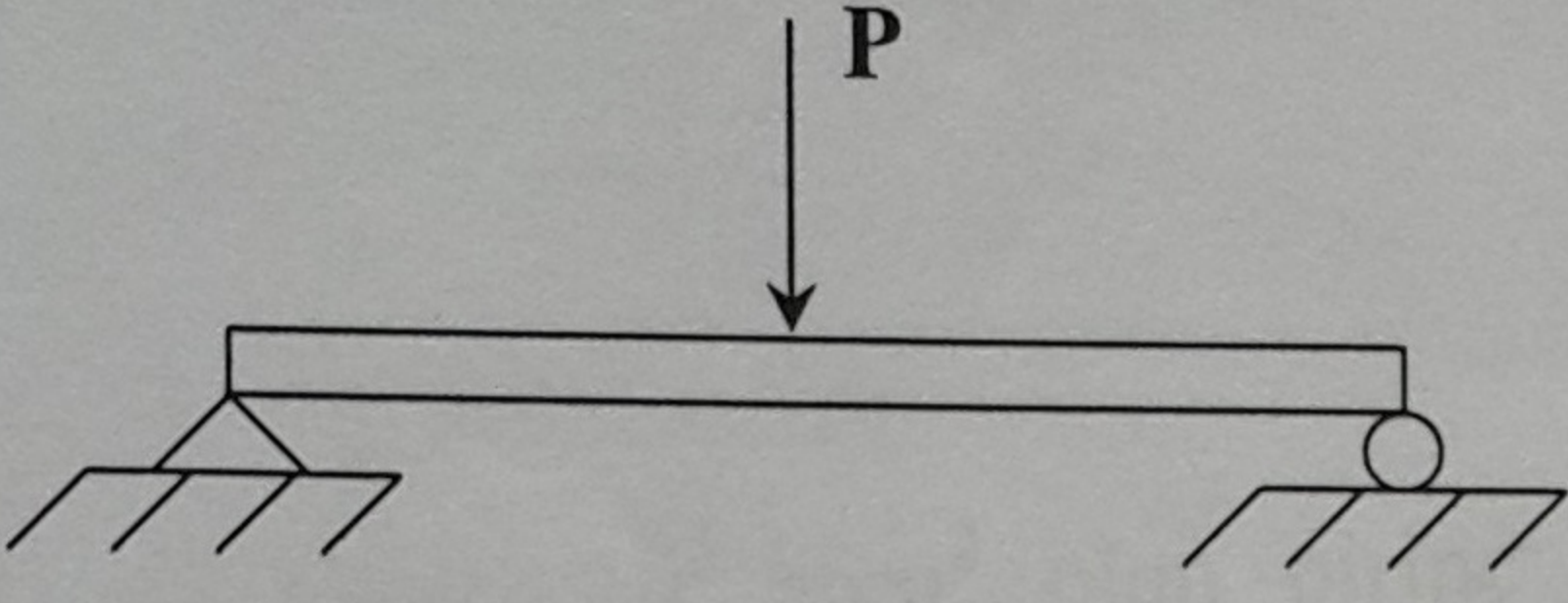


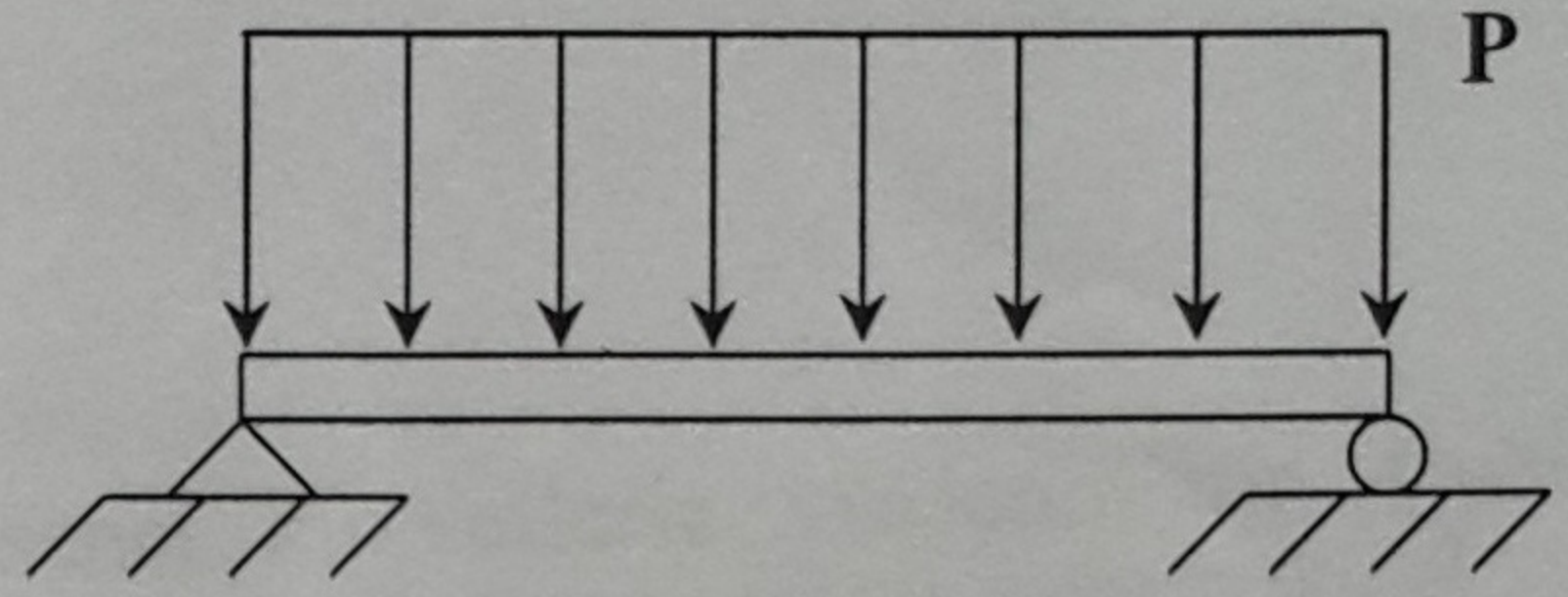
## SU ÜRÜNLERİ FAKÜLTESİ MUKAVEMET ARA SINAV SORULARI 24.11.2011

Sınav süresi 120 dakikadır. Notlar kapalıdır, hesap makinesi kullanılabilir. Cevaplar okunaklı ve anlaşılır olarak yazılmalı, tüm hesaplamalar cevap kağıdında gösterilmelidir. Aksi takdirde yapılanlar dikkate alınmayacaktır. Başarılar dilerim.

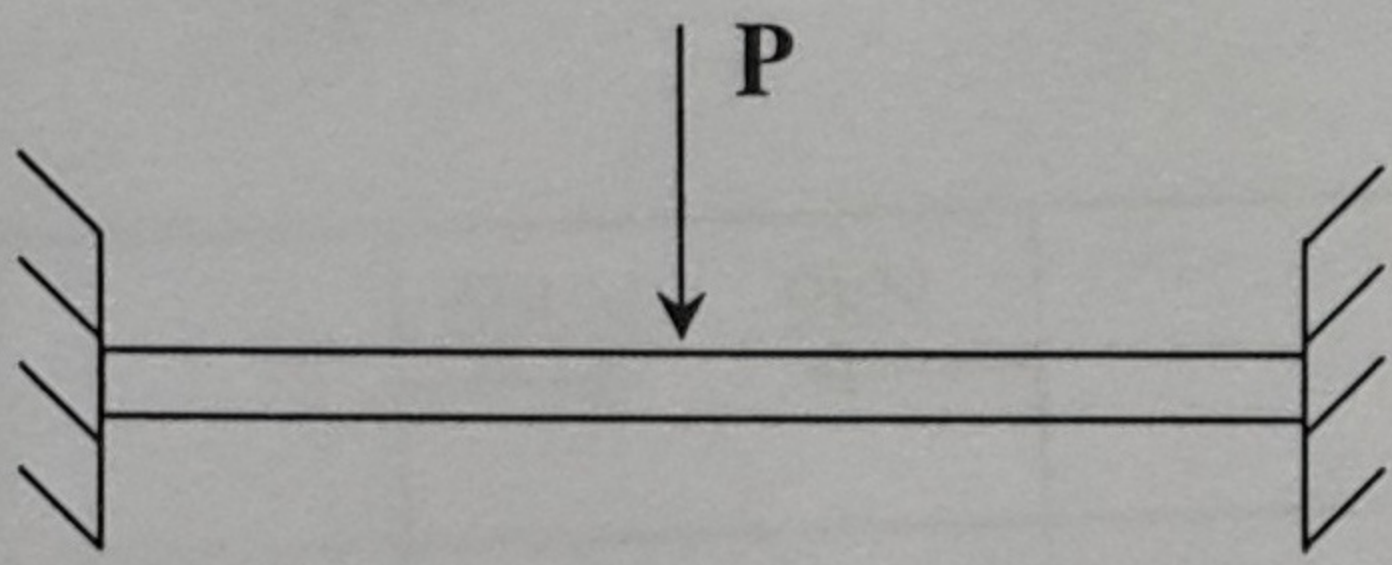
**SORU 1:** Aşağıdaki kirişlere değeri bilinen  $P$  kuvveti/kuvvetleri uygulanmaktadır. Kiriş yapılarını statik olarak belirli ve belirsiz olmaları açısından sınıflandırınız. Her bir kiriş için nedenleri analitik olarak vererek açıklayınız.



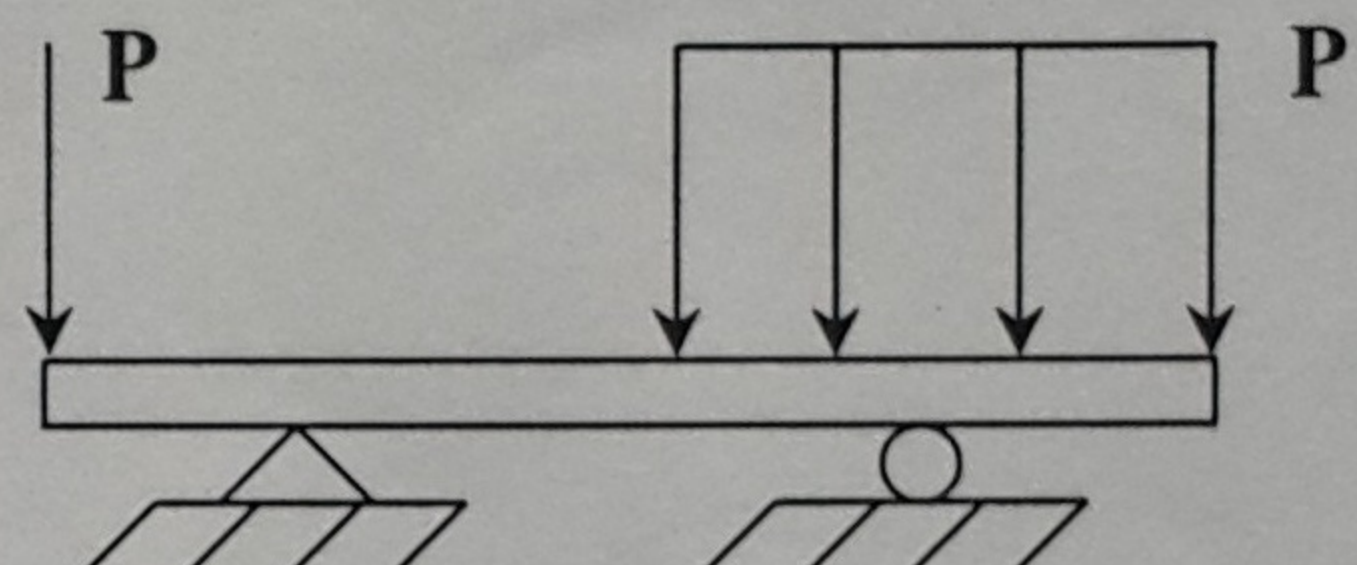
(a)



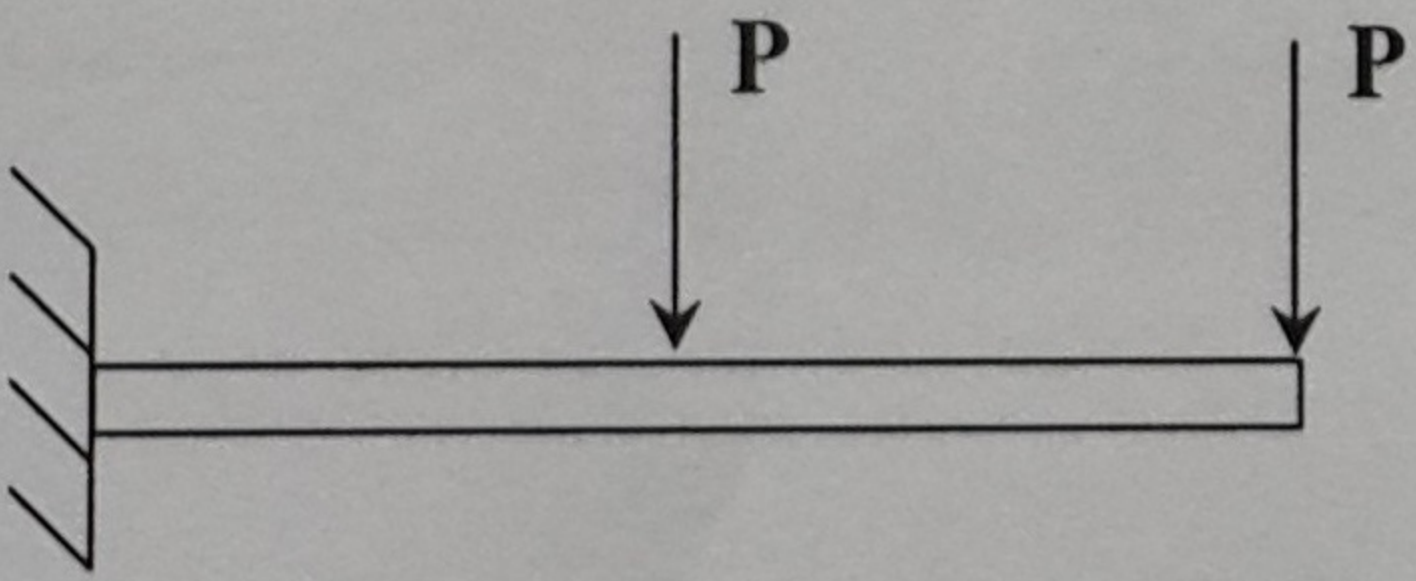
(b)



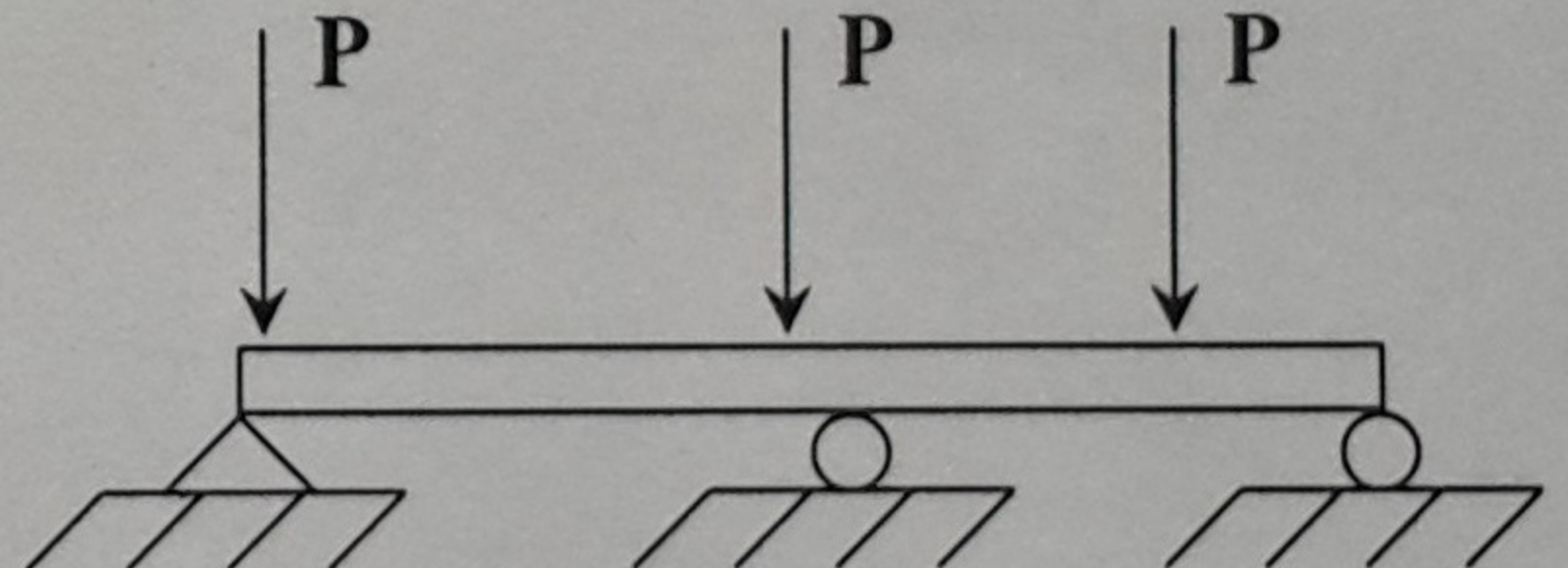
(c)



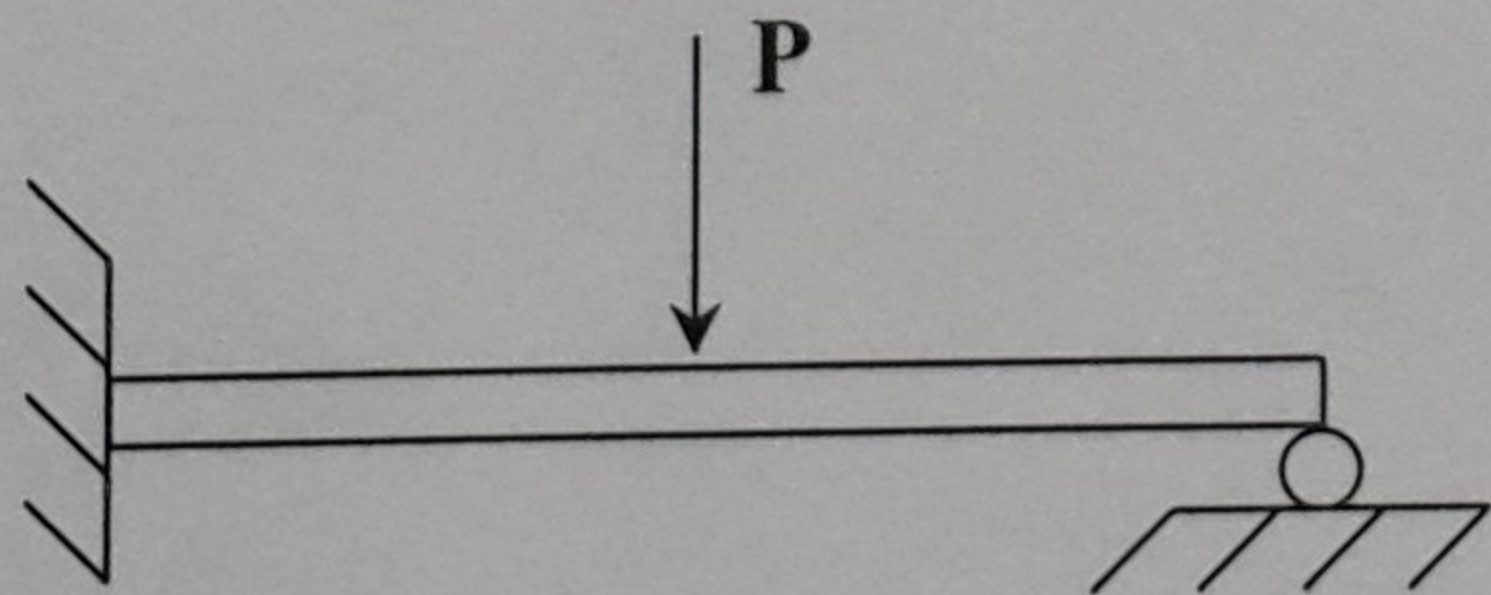
(d)



(e)

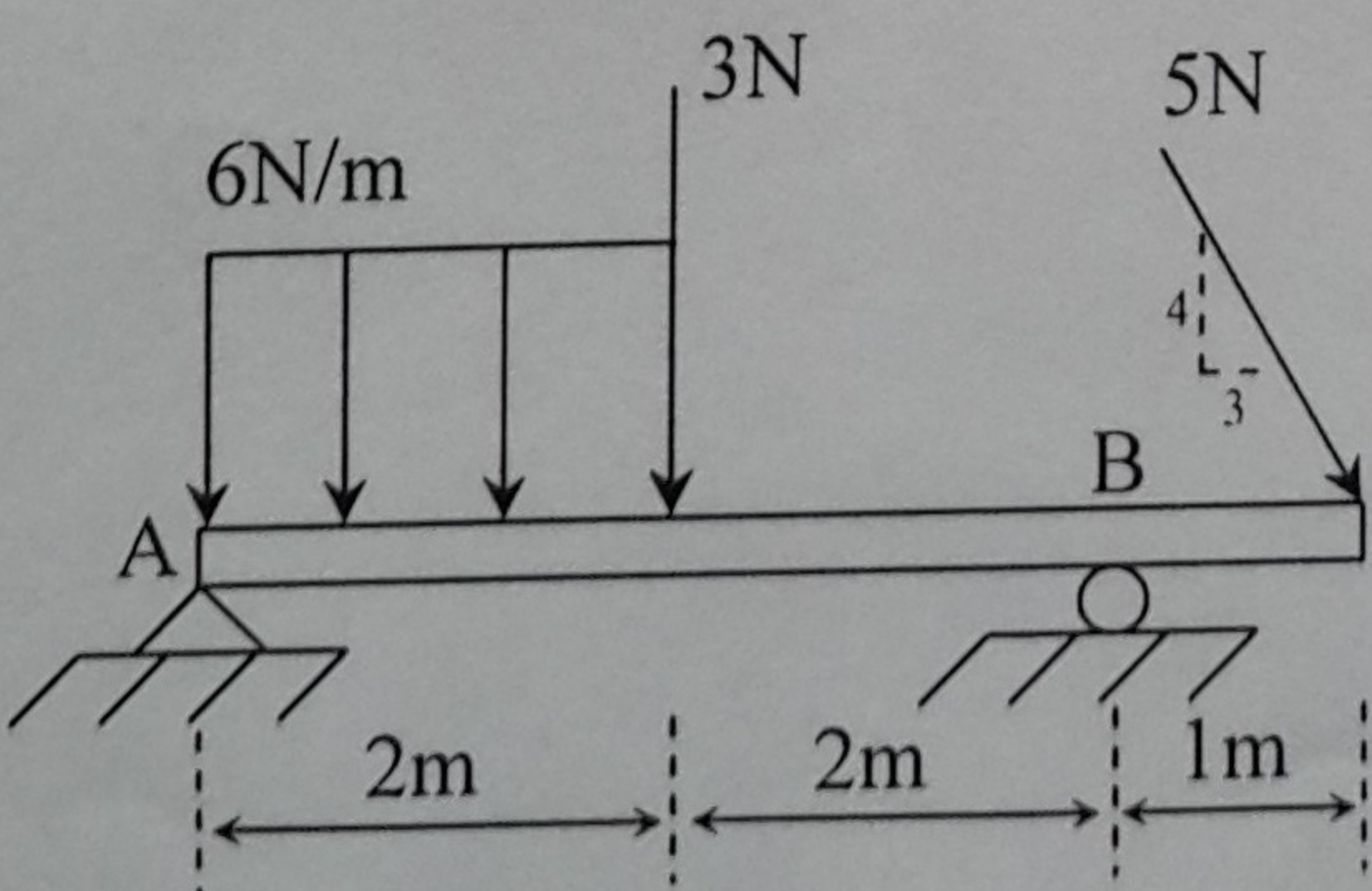


(f)



(g)

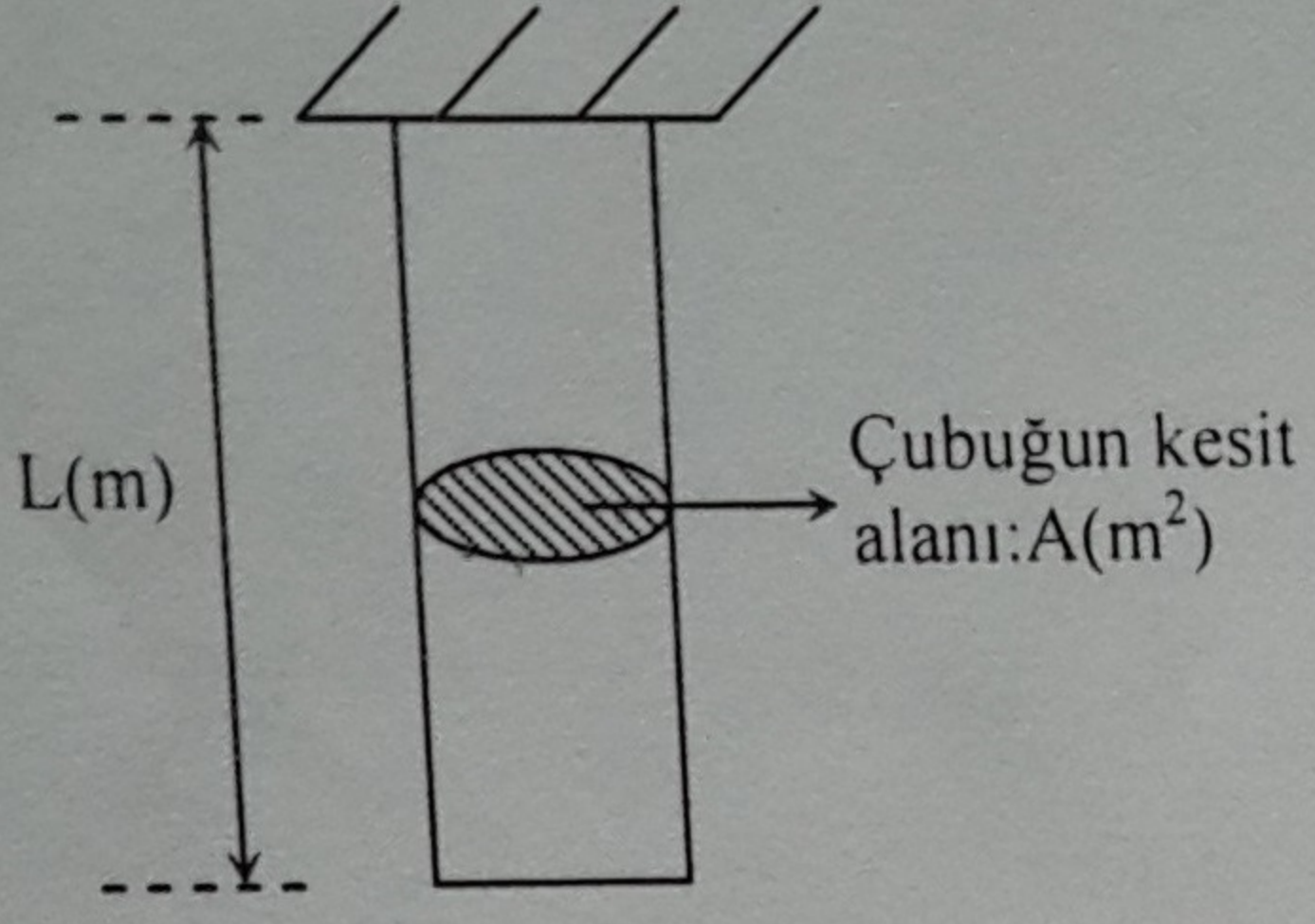
## SORU 2:



Şekilde görülen kirişin normal kuvvet, kesme kuvveti ve eğilme momenti diyagramlarını kesit yöntemiyle, hepsi alt alta gelecek şekilde, çiziniz.



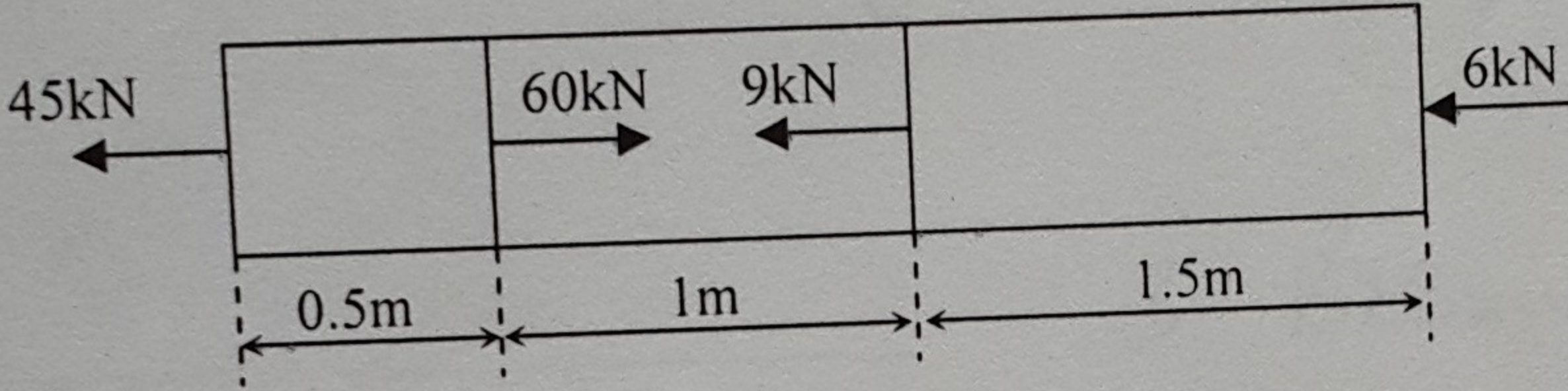
**SORU 3:**



Düşey olarak tavana asılı sabit kesitli bir çubuğun yalnız kendi ağırlığından ötürü oluşan toplam uzama miktarını parametrik olarak ( $A$ ,  $L$ ,  $E$ ,  $W$  cinsinden) bulunuz.

Çubuğun elastik modülü,  $E$  ( $GN/m^2$ )  
Çubuğun ağırlığı:  $W$  ( $N$ )

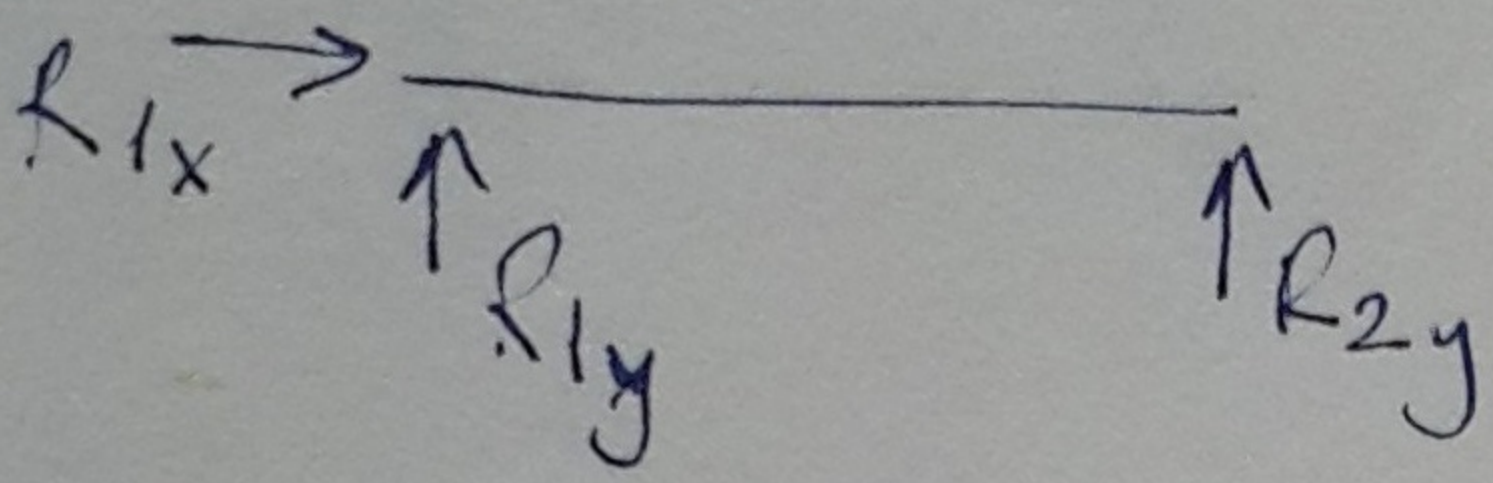
**SORU 4:** Kesiti  $10^3 \text{ mm}^2$  olan pirinç çubuk aksel kuvvetlerle yüklenmiştir. Çubuk dengededir. Çubuğun toplam uzamasını bulunuz. Pirinç için elastik modül,  $E = 90 \text{ GN/m}^2$ .





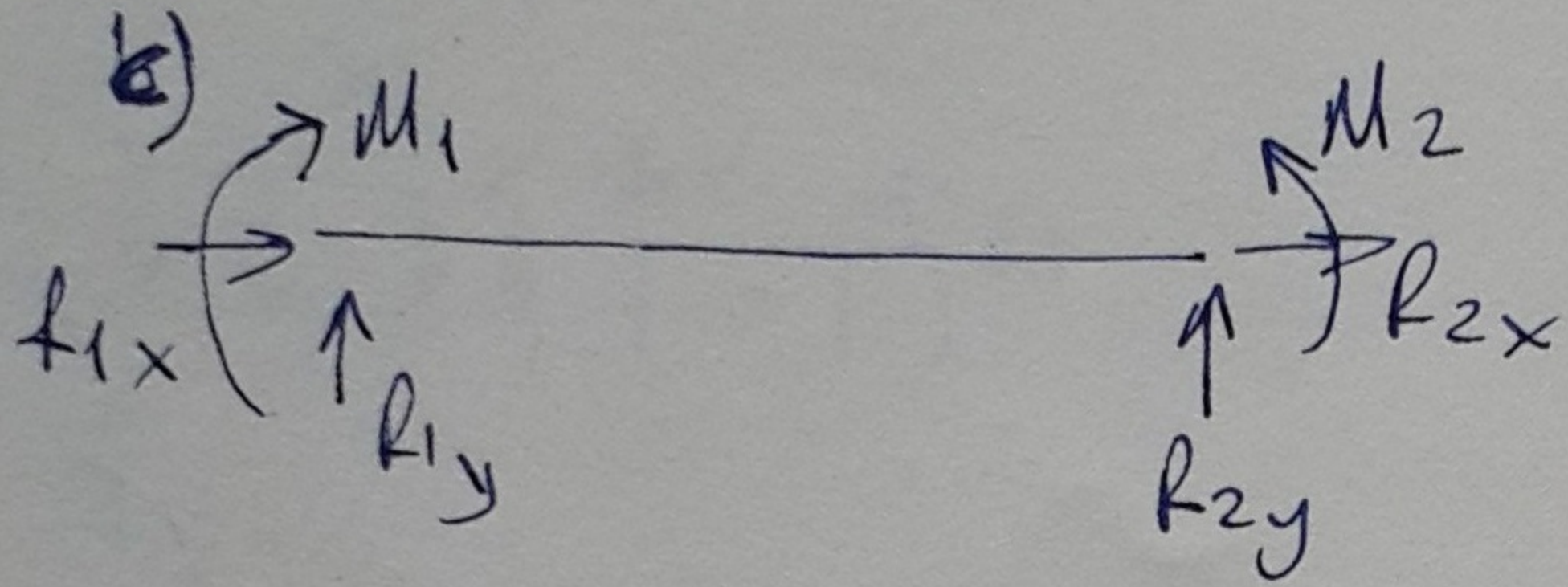
SORU 1

a)



3 Bilinmeyen  $\Rightarrow$  Statik olarak belinli!

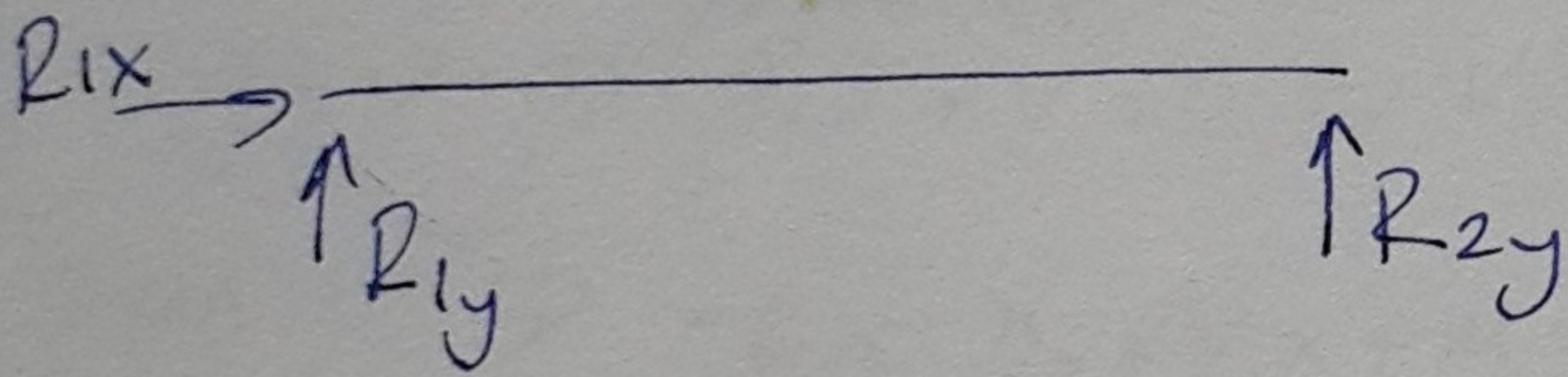
3 Puan



6 Bilinmeyen  $\Rightarrow$  Belirsiz

3 Puan

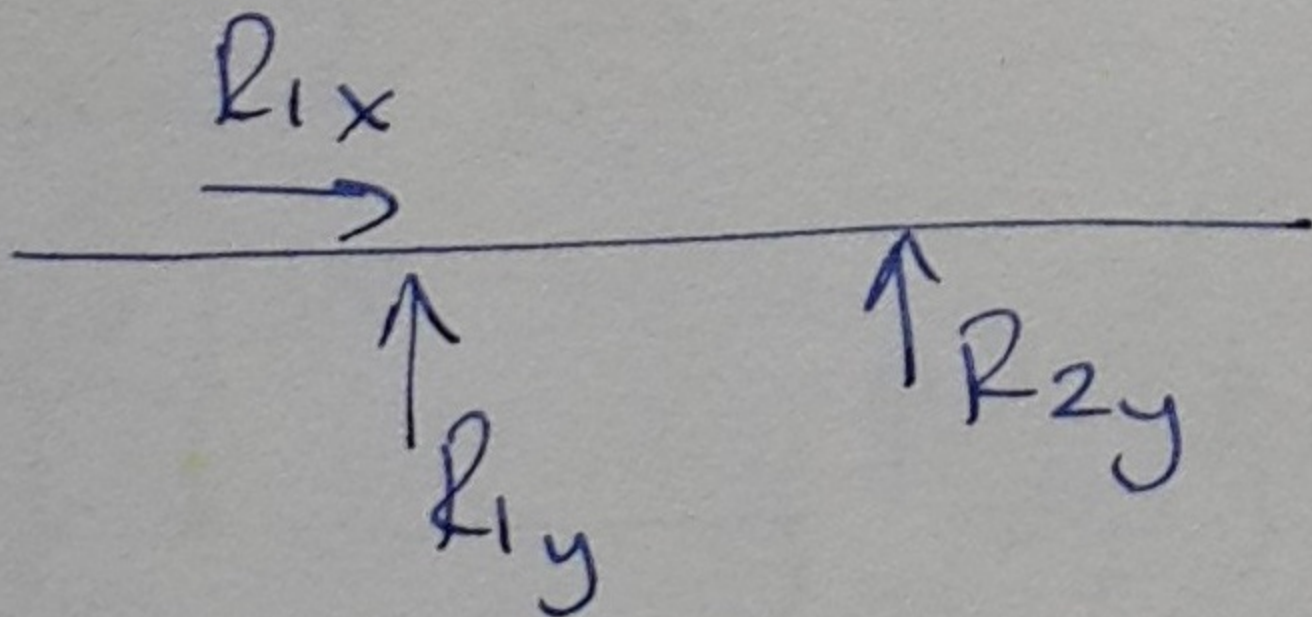
b)



3 Bilinmeyen  $\Rightarrow$  Belinli

3 Puan

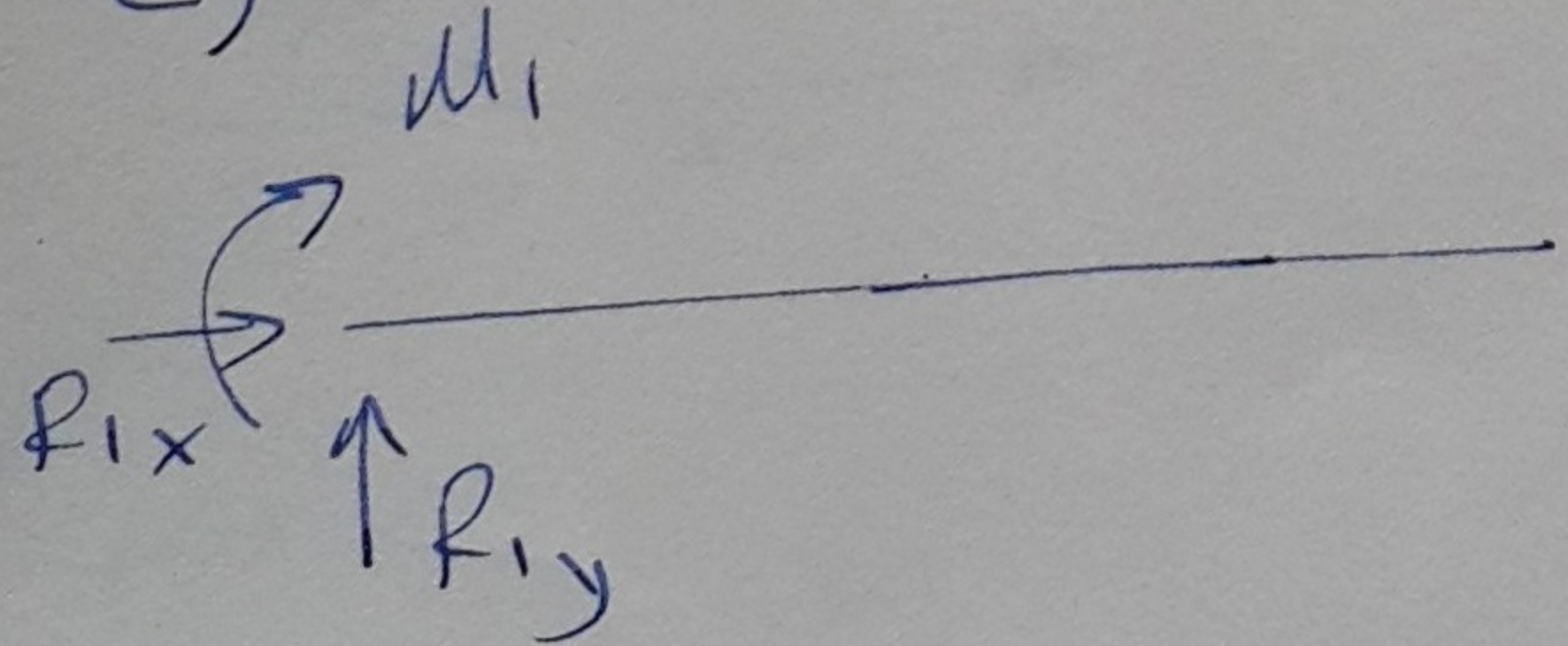
d)



3 Bilinmeyen  $\Rightarrow$  Belinli

3 Puan

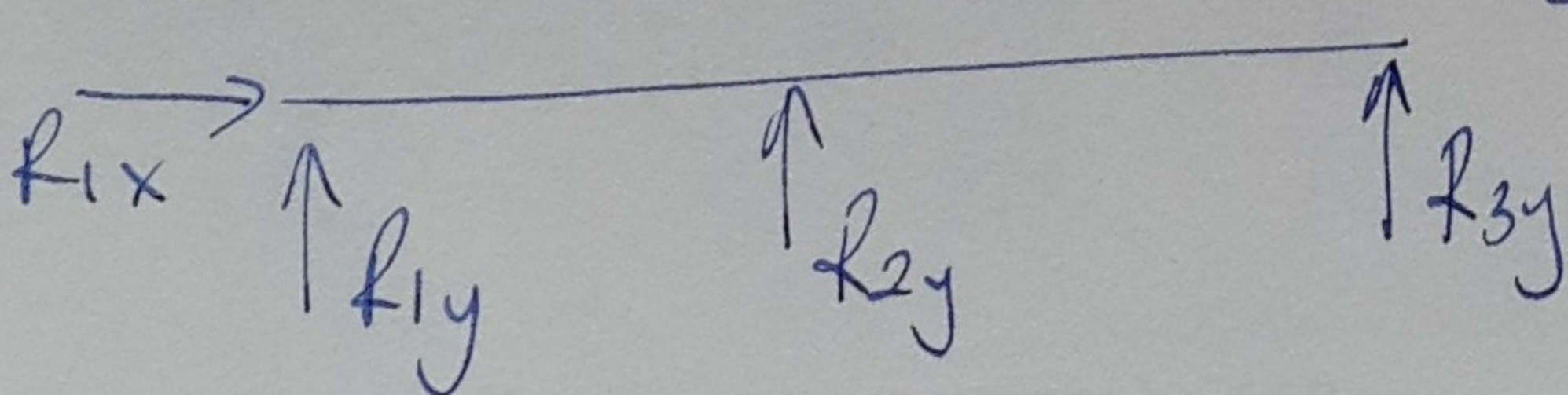
e)



3 Bilinmeyen  $\Rightarrow$  Belinli

3 Puan

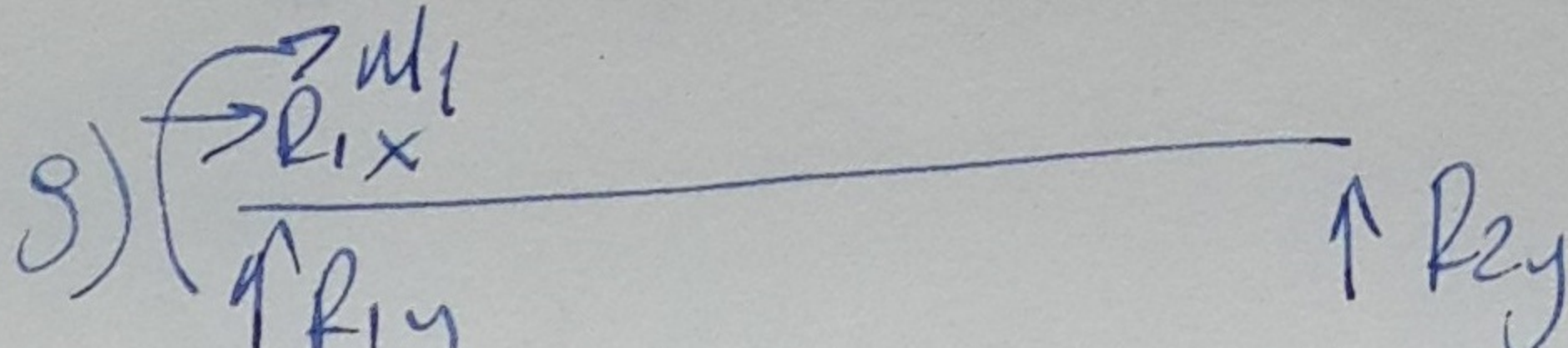
f)



4 Bilinmeyen  $\Rightarrow$  Belirsiz.

3 Puan

g)

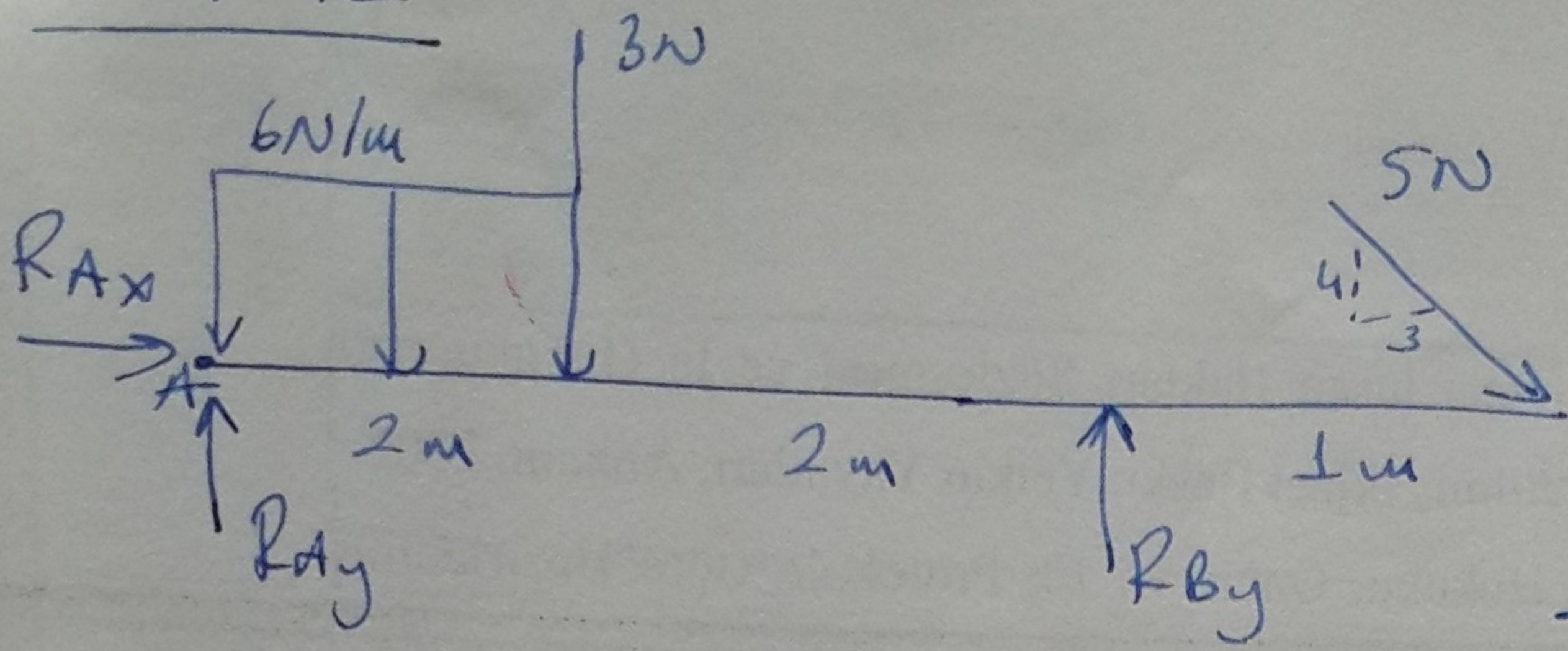


4 Bilinmeyen  $\Rightarrow$  Belirsiz.

3 Puan



SORU 2



$$\sum F_x = 0$$

$$R_{Ax} + 5 \cdot \frac{3}{5} = 0 \Rightarrow R_{Ax} = -3 \text{ N}$$

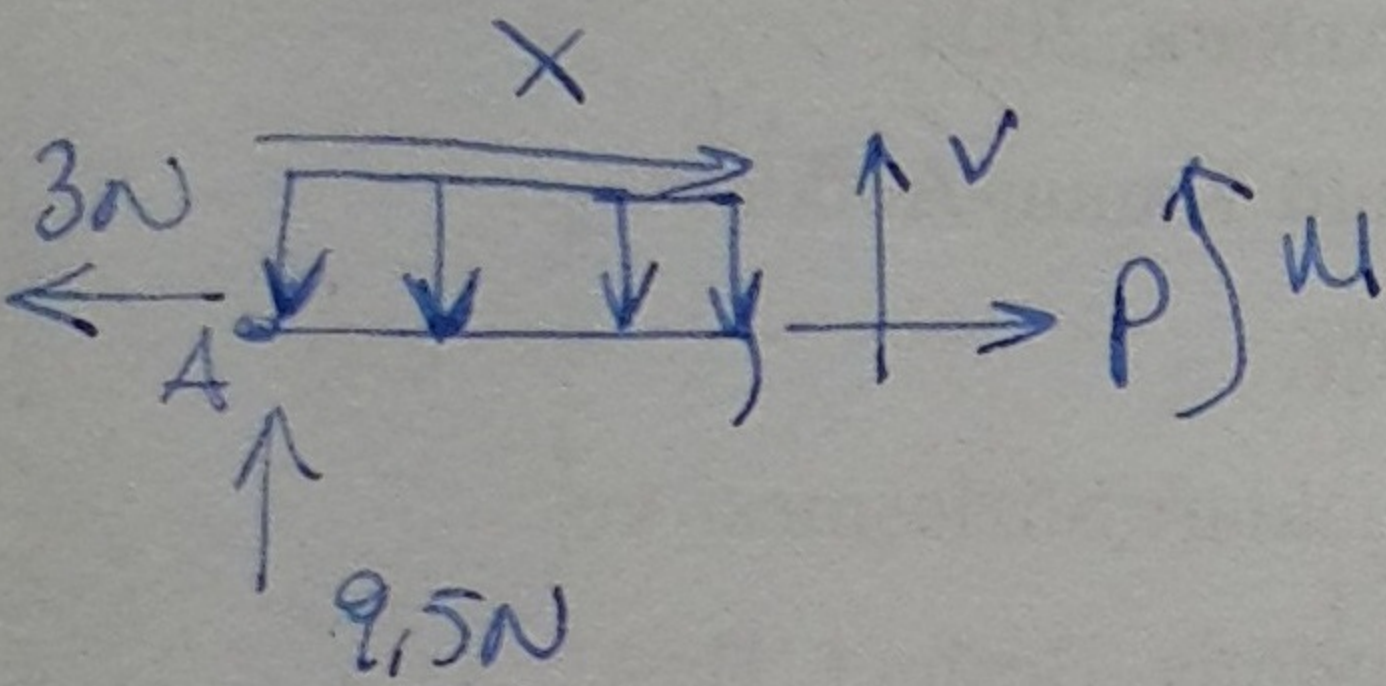
2 puan

$$\sum F_y = 0$$

$$-6 \cdot 2 - 3 + R_{Ay} + R_{By} - 5 \cdot \frac{4}{5} = 0$$

$$R_{Ay} + R_{By} = 19 \text{ N}$$

$0 < x < 2$  için



$$\sum F_x = 0 \Rightarrow -3 + P = 0 \Rightarrow P = 3 \text{ N} \quad (1)$$

$$\sum F_y = 0 \Rightarrow 9.5 + V - 6 \cdot x = 0 \Rightarrow V = -9.5 + 6x \quad (2)$$

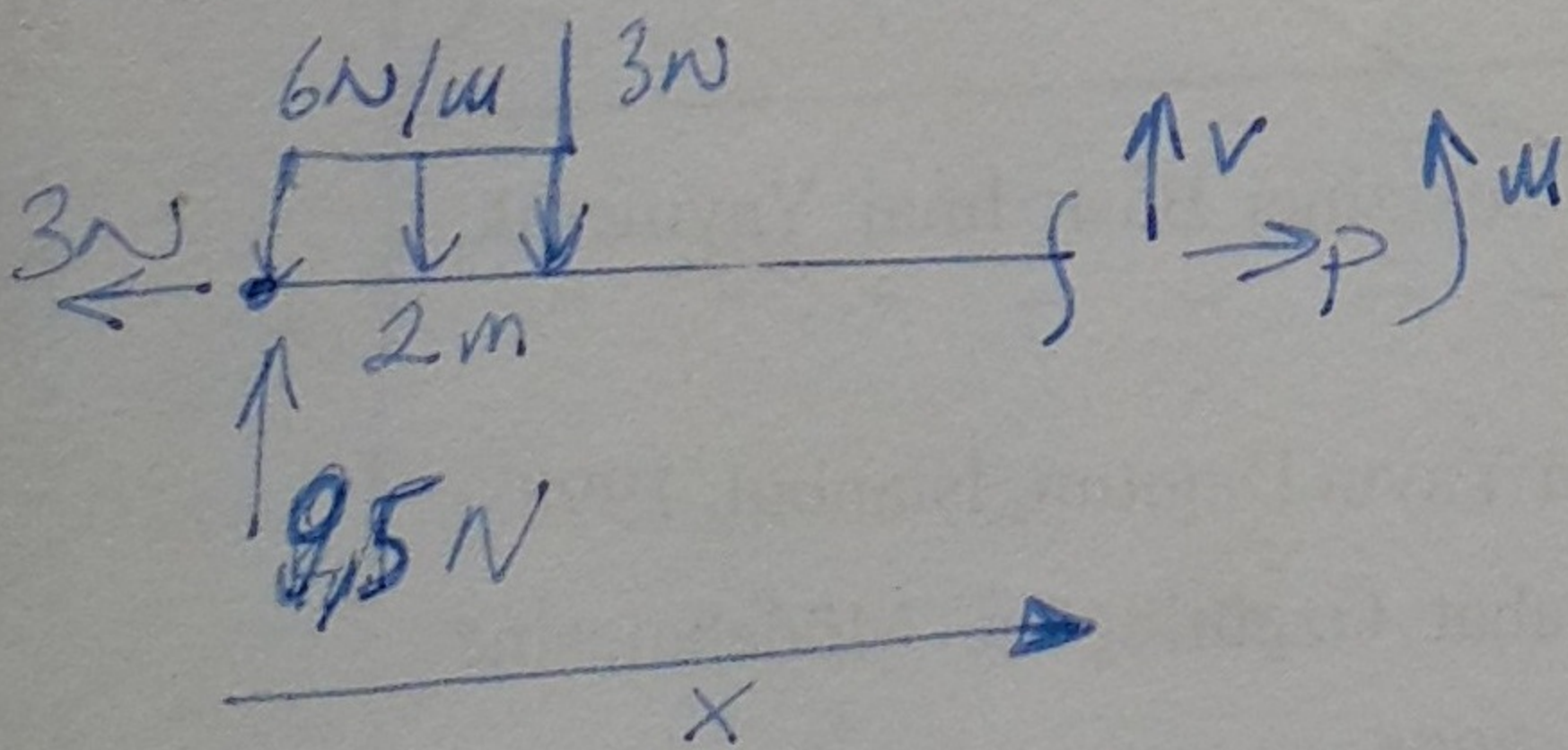
$$\sum M_A = 0 \Rightarrow -6 \cdot x \cdot \frac{x}{2} + Vx + M = 0 \Rightarrow M = 3x^2 - Vx = 3x^2 - (-9.5 + 6x) \cdot x$$

$$M = 3x^2 + 9.5x - 6x^2 = -3x^2 + 9.5x \text{ Nm} \quad (2)$$

2 puan

2 puan

$2 < x < 4$  için



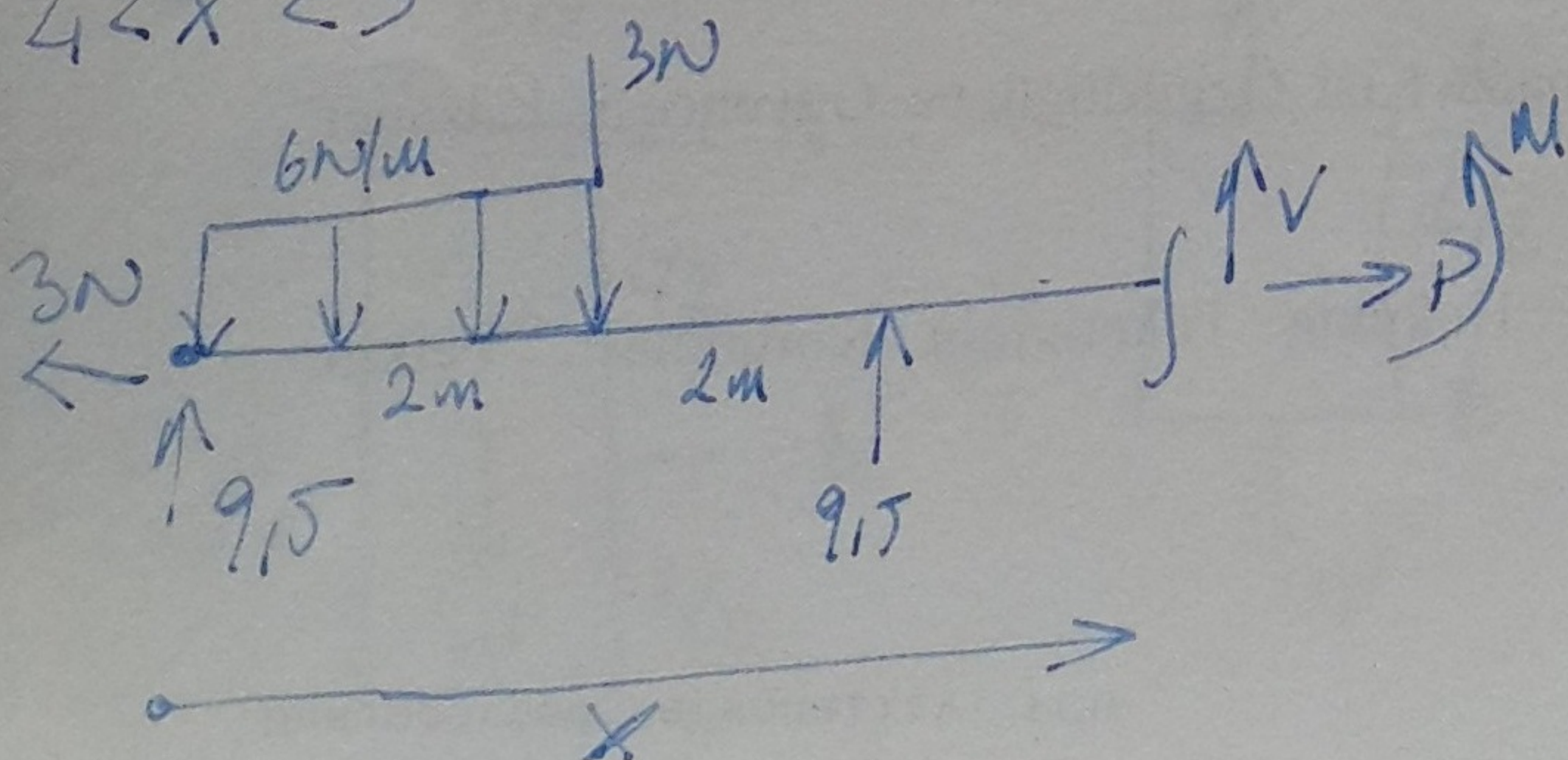
$$\sum F_x = 0 \Rightarrow -3 + P = 0 \Rightarrow P = 3 \text{ N}$$

$$\sum F_y = 0 \Rightarrow -6 \cdot 2 - 3 + V + 9.5 = 0 \Rightarrow V = 5.5 \text{ N} \quad (2)$$

$$\sum M_A = 0 \Rightarrow -6 \cdot 2 \cdot 1 - 3 \cdot 2 + V \cdot x + M = 0$$

$$M = -5.5x + 18 \text{ Nm} \quad (2)$$

$4 < x < 5$



$$\sum F_x = 0 \Rightarrow P = 3 \text{ N}$$

$$\sum F_y = 0 \Rightarrow -6 \cdot 2 - 3 + 9.5 + 9.5 + V = 0$$

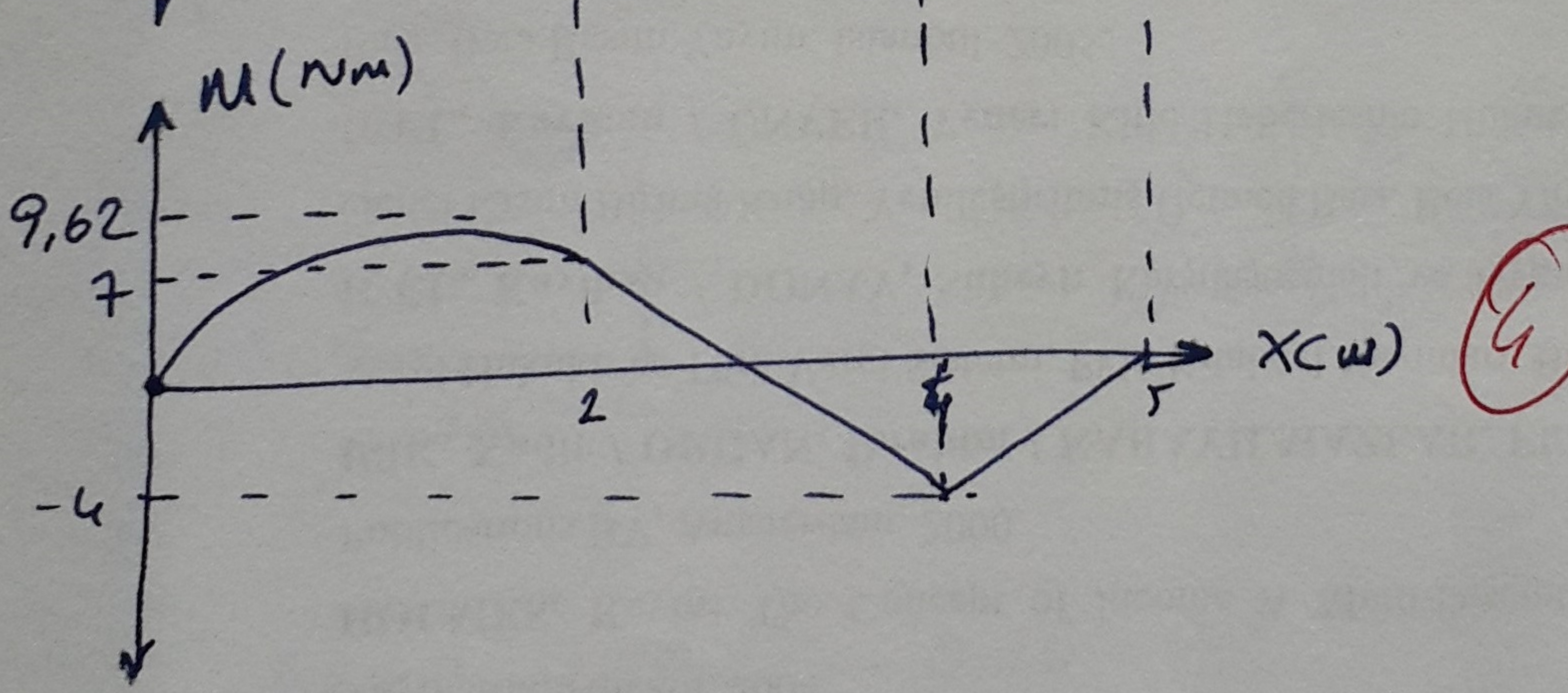
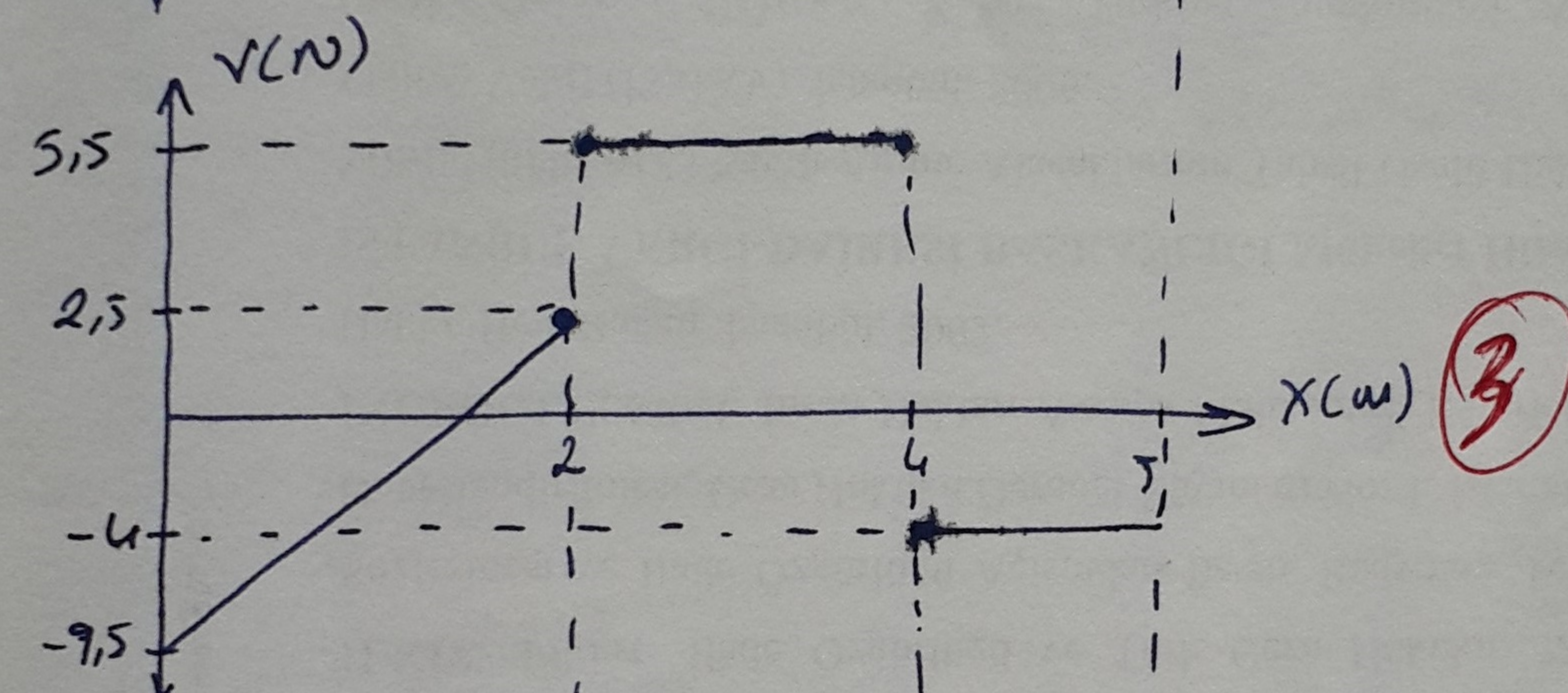
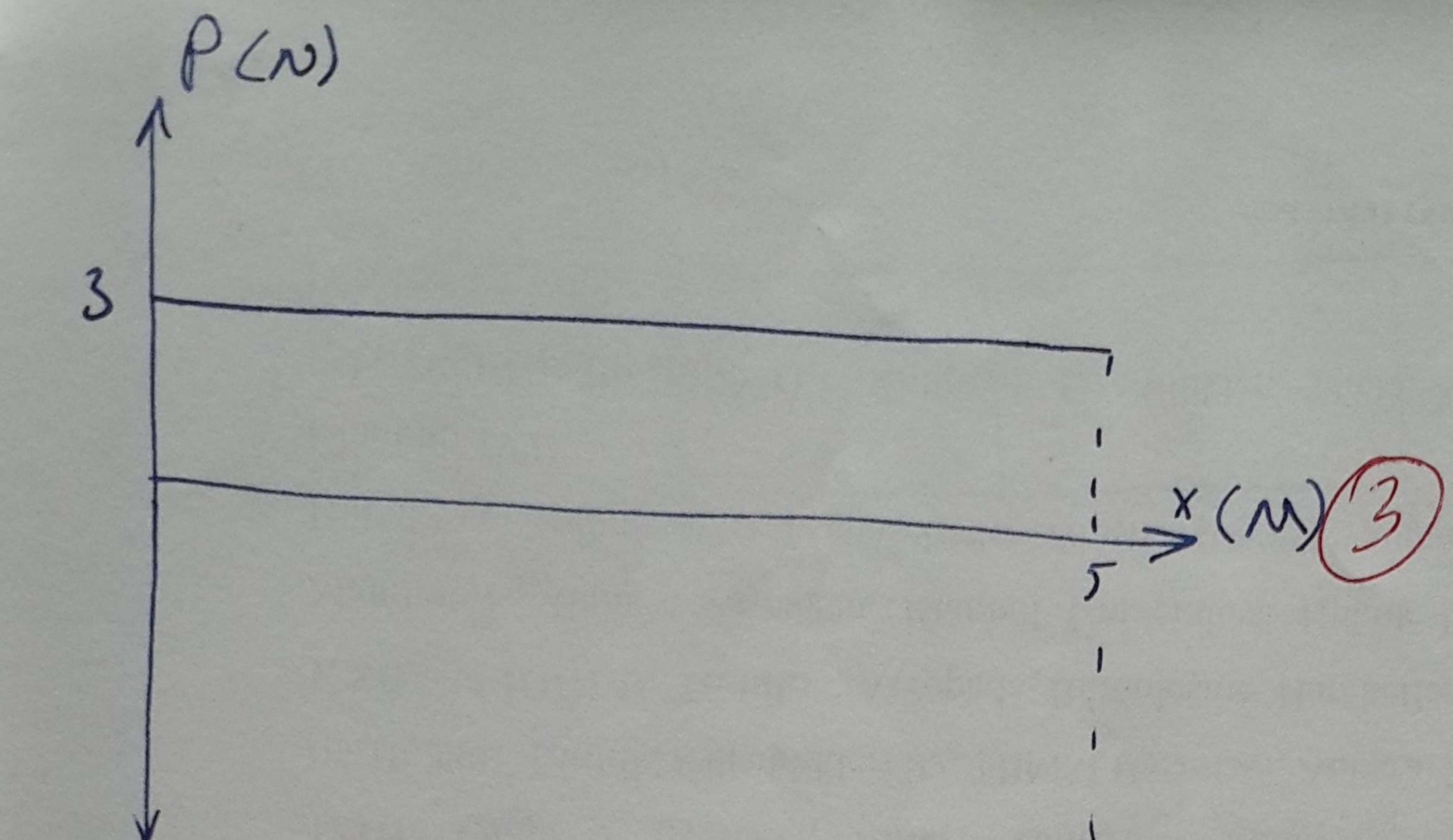
$$V = -4 \text{ N} \quad (2)$$

$$\sum M_A = 0 \Rightarrow -6 \cdot 2 \cdot 1 - 3 \cdot 2 + 9.5 \cdot 4 + Vx + M = 0$$

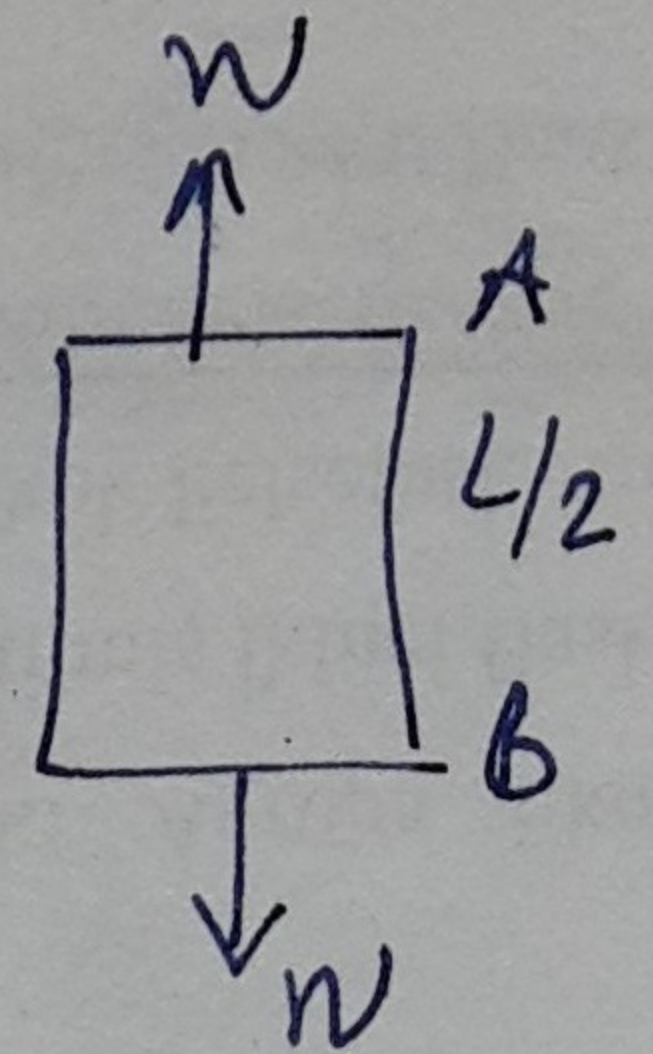
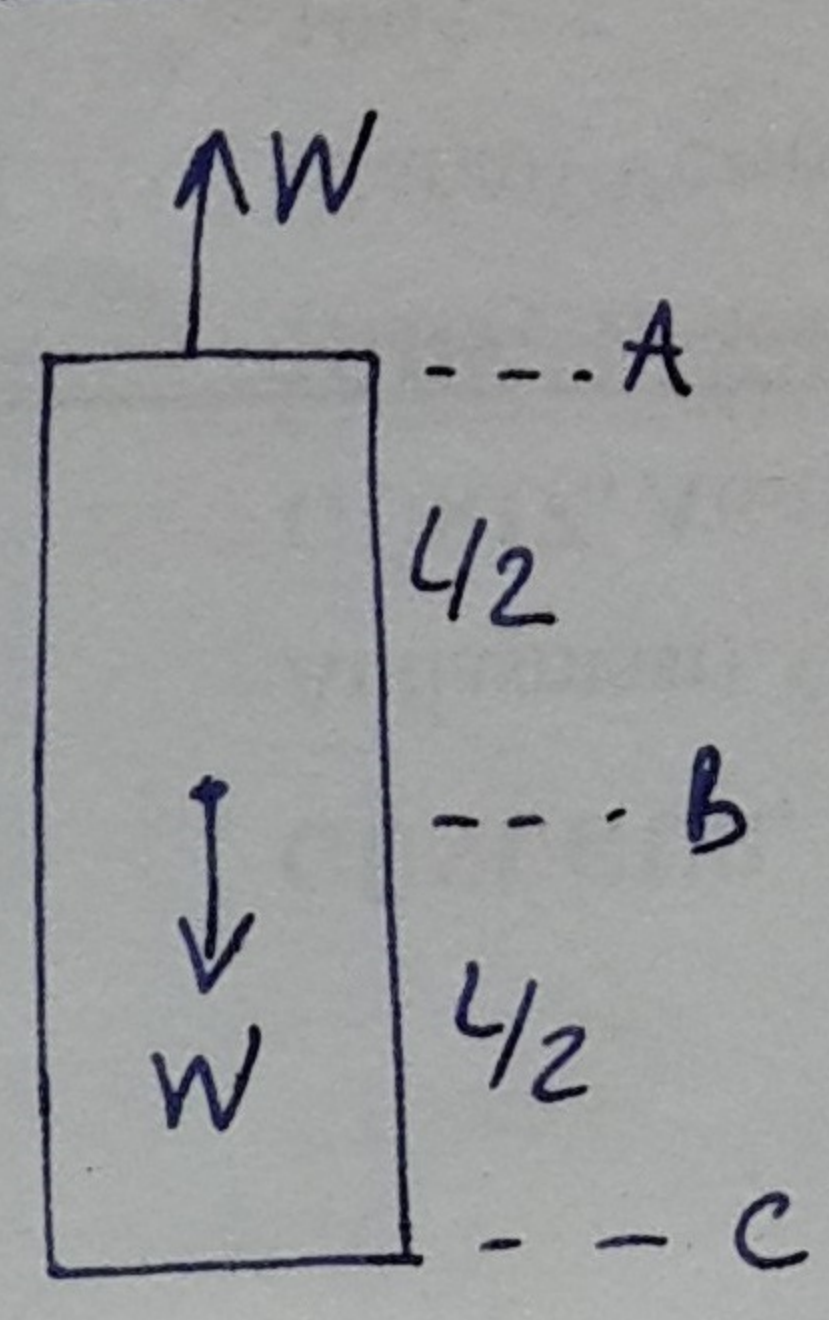
$$M = 4x - 20 \text{ Nm} \quad (2)$$

(2)

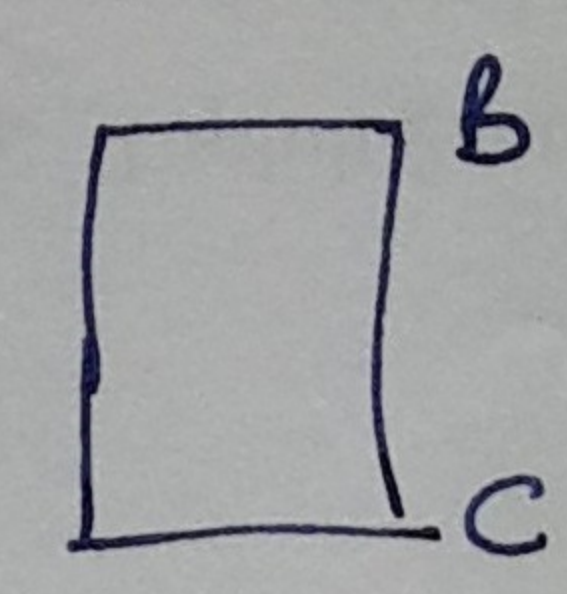




SORU 3



$$\Delta l = \frac{F \cdot l}{A \cdot E} = \frac{W \cdot 1/2}{A \cdot E} \quad (10)$$

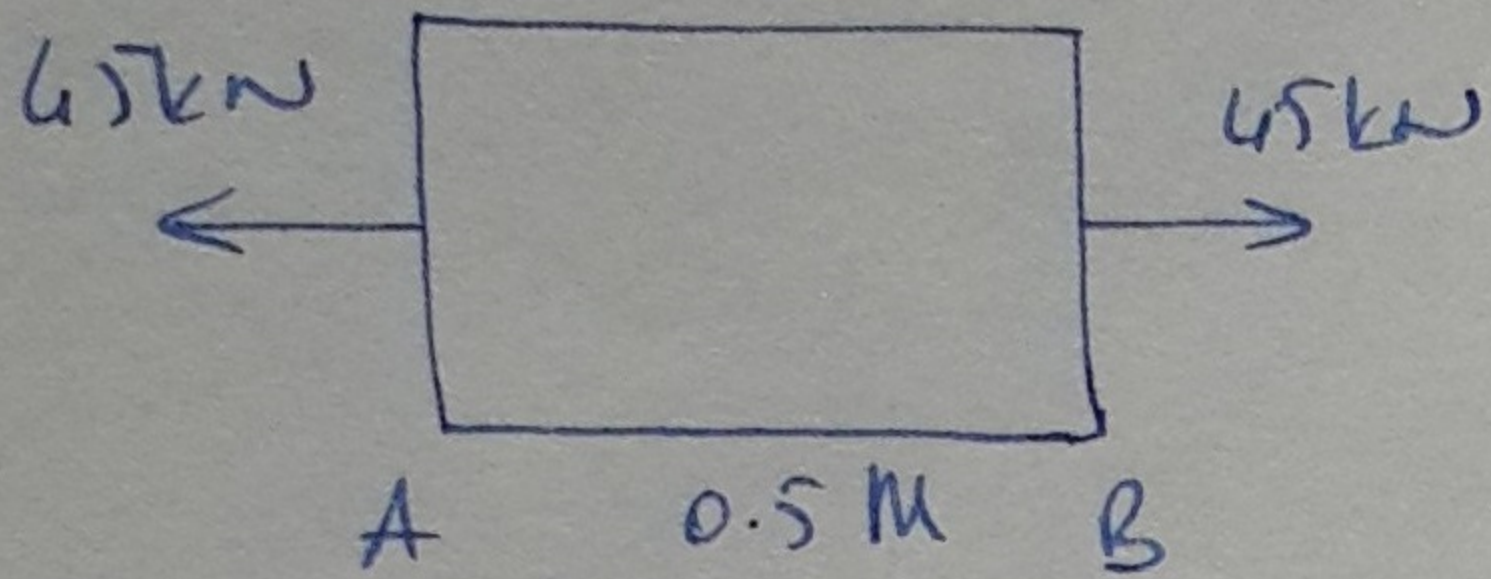
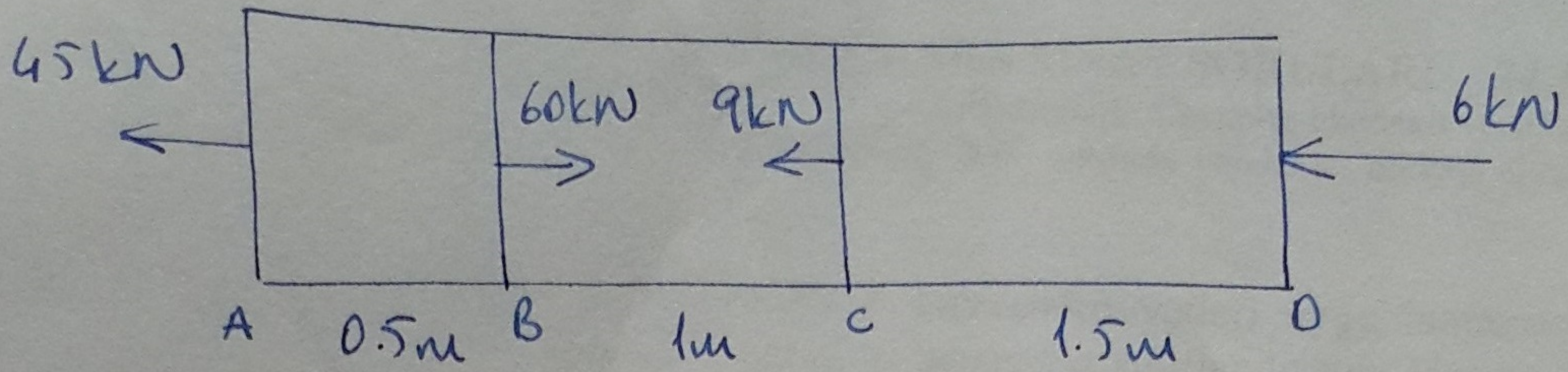


$$\Delta l = \frac{F \cdot l}{A \cdot E} = \frac{0 \cdot 1/2}{A \cdot E} = 0 \quad (10)$$

$$\Rightarrow \Delta l_{\text{toplam}} = \frac{W \cdot L}{2AE} \quad (5)$$

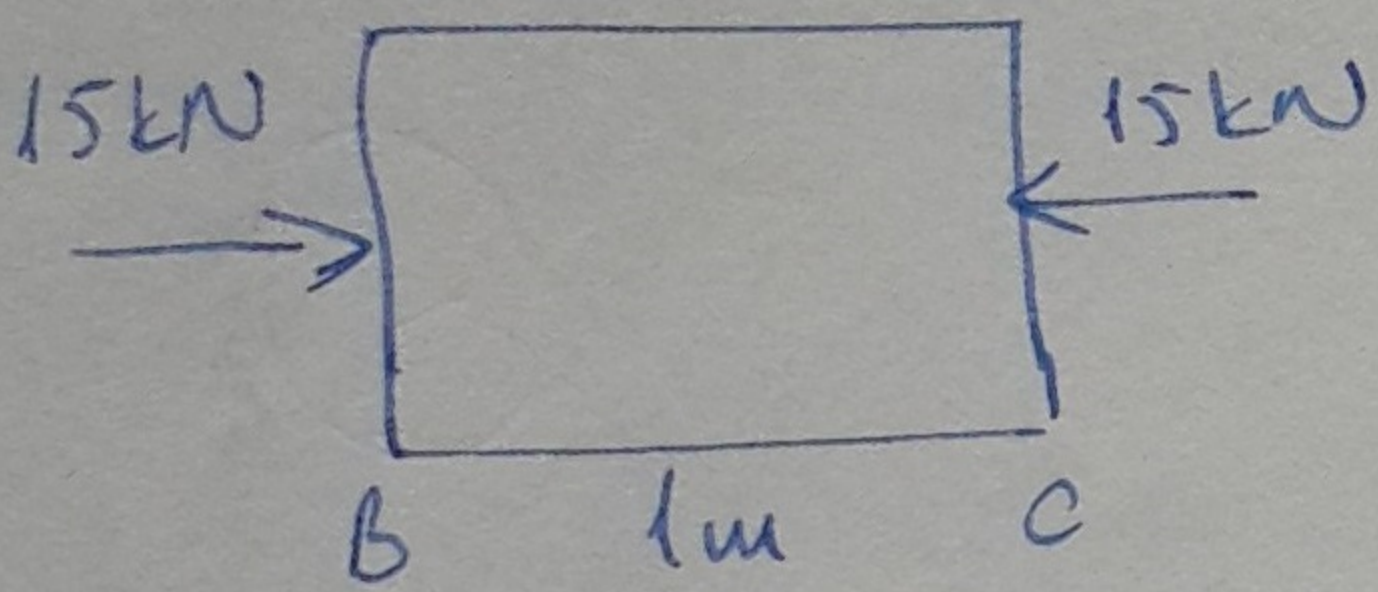


SORU 4:



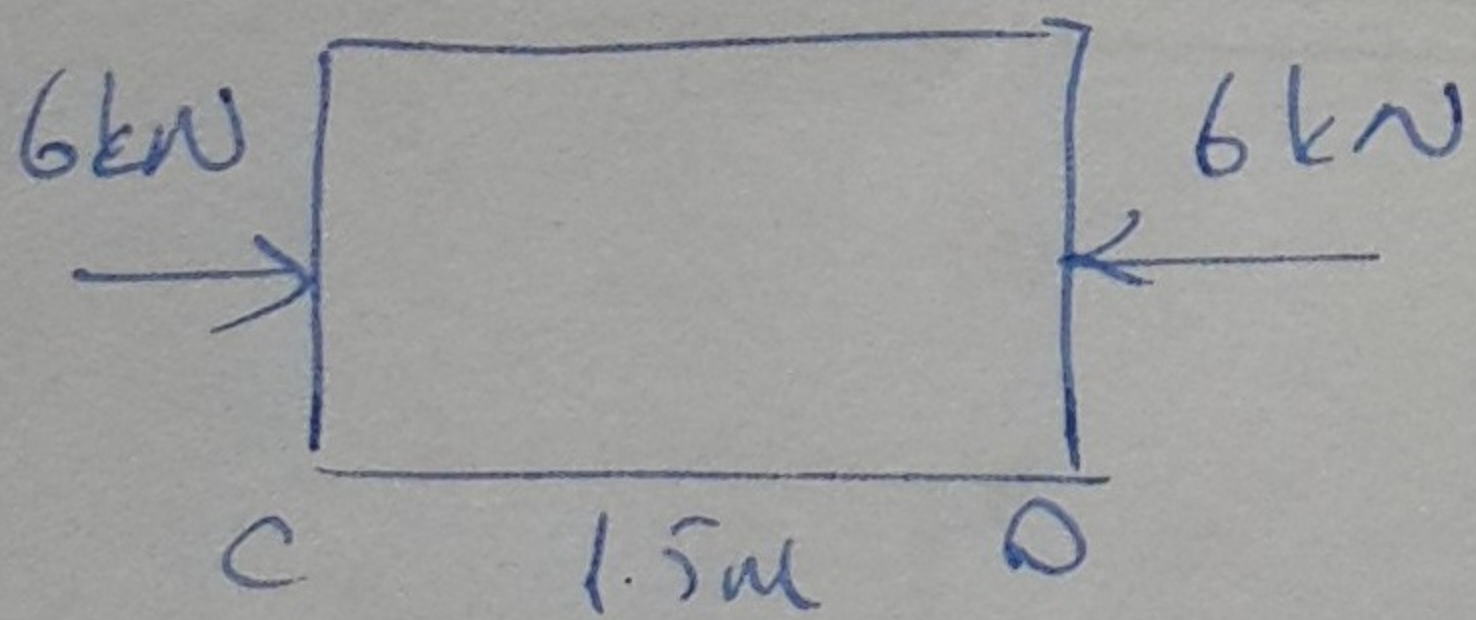
$$\Delta l_1 = \frac{45 \times 10^3 \text{ N} \cdot 0,5 \text{ m}}{10^3 \times 10^{-6} \text{ m}^2 + 90 \times 10^9 \frac{\text{N}}{\text{m}^2}} = 0,25 \text{ mm} \quad (\text{GEMME})$$

(5)



$$\Delta l_2 = \frac{15 \times 10^3 \text{ N} \cdot 1 \text{ m}}{10^3 \times 10^{-6} \text{ m}^2 + 90 \times 10^9 \frac{\text{N}}{\text{m}^2}} = 0,16 \text{ mm} \quad (\text{BASMA})$$

(5)



$$\Delta l_3 = \frac{6 \times 10^3 \text{ N} \cdot 1,5 \text{ m}}{10^3 \times 10^{-6} \text{ m}^2 + 90 \times 10^9 \frac{\text{N}}{\text{m}^2}} = 0,1 \text{ mm} \quad (\text{BASMA})$$

(5)

$$\Delta l_{\text{toplam}} = 0,25 - 0,16 - 0,1 = -0,01 \text{ mm}$$

(10)

Birim yanlış yazılırsa -3 puan!